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All communications should be addressed to the Editor.

No. 87. MARCH, 1918. Vol. XXII.

Notices of the Aëronautical Society of Great Britain.

New Members (76).

The following have been elected:—

Fellows.—Captain F. M. Green, E. P. Ecriceson, F. G. Diffin, F. H. Bramwell, A. Fage, James Hartness (6).

Associate Fellows.—G. E. Folkes, H. B. Howard, P. V. Hoare, A. C. Stevenson, Lieutenant-Colonel O. T. Gnosspelins, Captain V. S. Brown, F. Meadows, S. Brodetsky, W. T. Reed, W. Morris Jones, W. H. Seabrook, W. R. Jenkins, W. E. John, Captain Percy Bishop, W. A. Hargreave, M. F. Magill, C. A. Wright, J. W. Ratcliffe, R. N. Liptrot, C. Cooper, F. E. Pollard, C. G. N. Richardson, Captain W. G. Aston, Lieutenant E. B. Falkner (24).

Members.—W. P. Johnson, F. Campbell, T. J. Whiting, S. Grimsby, H. Witman, Sir Mackenzie Chalmers, A. Thatcher, John Bowsie, W. T. Kenney (9).

Students.—H. Wise, C. H. Enders, H. R. F. Cliff, J. C. Young, N. Davey, A. W. Mayo, W. R. Turner, J. W. S. Yates, W. Widgery, L. Fossett, M. R. Woodrow, G. Brodsky (12).

Associate Members.—F. G. Smith, J. Hall, A. F. Milton, E. Hopkins, W. S. Grant, G. J. Turner, J. Southall, L. A. Sweny, F. W. Hills, T. Shoda, J. M. Sadler, Lieutenant H. J. Cardwell Harper, E. W. Harrison, F. Gregory, B. A. Reece, A. Maclennan, O. Hodgson, M. McKeon, C. H. Witty, C. Crawford, P. R. Jacklin, F. W. Atkinson (24).

Foreign Members.—Colonel E. R. Wayland (Canada) (1).

Resigned.—D. P. Muirhead, A.M.

The Library.

The cataloguing of the Library has now been completed, while the binding of a large accumulation of periodicals has also been carried out and some neces-

sary purchases of the later text books are proceeding. The collection of portraits of the founders of the Society has received several additions. Mr. Hatton Turnor has presented a picture of his father, the author of "Astra Castra," and Mrs. F. H. Wenham a portrait of Captain F. H. Wenham, the originator of Military Ballooning in the British Army. Engravings of the Duke of Sutherland and the Earl of Dufferin have been presented by the Secretary.

Honours and Awards.

Commodore Sir G. M. Paine, Associate Fellow, has been appointed K.C.B.

SHOP ORGANISATION: A SIMPLE SCHEME.

BY W. E. JOHN, ASSOCIATE FELLOW.

During my visit to Great Britain I have been surprised to find how many factories have sprung up during the war, which whilst producing munitions of a highly complicated character lack a staff, the members of which as a whole possess that long and careful experience in technical production always considered necessary in the qualifications of men for executive or responsible positions.

Yet the fact remains that these concerns are producing, and the product in many cases is of a high quality. We are, however, living in exceptional times, when competition—in the true sense of the word—is absent; but if the best is to be obtained now and in the future, when these factories will have to strain every effort for their existence, it will be necessary that production on a strictly economical basis be considered.

My experience shows that in a number of cases there exists a misconception of what a proper system of control means, and the advantage accruing therefrom is unknown. Many there are, no doubt, who appreciate proper organisation but know so little of how to set about it that they hesitate to tackle what is often considered to be one of the most complicated problems. Without doubt, some systems are the last word in complexity, but such complication is not necessary. In organisation, order is the central pivot, and flexibility the lubrication, but management is the force—the motive power.

It is my object to sketch the outline of a scheme for the organisation of a factory. I neither pretend, nor is it my aim, to exhaust the subject, but shall apply the scheme to a modern factory, and hope so clearly to outline it, that it may be at least of some interest to the members. I may add that I have assisted in the mapping out and starting of two or three schemes or systems of organisation in England. A few days ago I was glad to read in a letter from an old "half section" of mine—a manager of a well known motor car factory and now engaged on the production of aeroplane engines, high explosive shells, motor war lorries, etc., in which he says, "It would do your heart good to see the easy and complete way the system which cost us so many long hours hammering out last year is now working. Visitors from other factories are frequently coming to see it in operation."

In order to illustrate the working, and in particular the flexibility of the scheme, I shall consider it applied to a factory producing aeroplanes. It will be sufficient if we consider the engine to be supplied complete and the machines made to Government orders.

At the beginning, it must be clearly understood that for successful control we must have management, and that means the existence of a real manager.

As is the manager, so will be the firm. If the manager does not take his own medicine—or, in other words, does not obey his rules, *i.e.*, the rules of the factory, framed and posted under his signature—then the whole concern will show lack of control. A manager's great qualification for his post should be that he can manage. A friend of the proprietor's, a shareholder, or any similar person, should not be considered from such a standpoint. Such a relation is not a qualification for the post under consideration, any more than a healthy appetite is a qualification for a chef.

This question of management cannot be too strongly put. A manager to manage men must be a man in every sense of the word. To-day, as never before, we have in our factories men of education and refinement, and the presence of a

weak or incompetent manager is recognised and felt at once, and the tone of the factory is, in a corresponding degree, lowered.

Now to the scheme; in the smallest or the largest concern, we must have a planning department. In the smallest concerns this department may occupy but a small part of the manager's brain and have very little visibility, but in a concern of any magnitude the planning department is very important.

The department should be divided into two sections—the commercial section and the productive section—or, more conveniently termed the costing section and the progress section. We have a cost department and sometimes a progress department in every works, but too often they are at loggerheads and have little in common with one another.

The man in charge of the planning department should have had a sound broad training and have ample initiative to meet emergencies. He should be capable of uniting the cost to the progress of the work. He should, of course, be strongly backed by the manager.

FORM 1 CONTRACT No. A463/13/1432
JOB No. W.G.P.

Mr. X
PLANNING DEPT

Put in hand:- 500 Waterman aeroplanes in lots of 50.

Drawings:- Air Board issue No 5.

Delivery: When:- First 50 in 6 weeks
Where:- Local Receiving Park
How:- By air

Order received From:- Contract Department Air Board
Price:- £740
Remarks:- At end of 7th month deliver 2nd 50 and thereafter 50 per month.

Date:- 23/11/17 Signed:- Z
MANAGER

Noted by Cost Section	Date	Signed:-
Ordered by Progress	Date	Signed:-

FORM 2 JOB No. W.P.G.

Mr. C
DRAWING OFFICE

Please supply drawings For:- Waterman aeroplanes

Drawings:- Air Board issue No 5.
Prepare First:- Metal parts
Follow in order mentioned with:- Sections 5. 2. 7.

When required:- As soon as possible
Remarks:- This month it is desired to start on as many metal fittings as possible.

Notify Planning Dept. of your progress.

Date:- 23/11/17 Signed:- S
PLANNING DEPT.

Received by Drawing Office	Date	Signed:-

Aeroplanes are admitted to be a very difficult product for a factory, because of the number of parts of widely different materials which go to make up the complete unit, and because of the constant minor changes which are occurring in their design. They are, however, not unique in this latter respect, as those engaged in the production of various other munitions can testify.

We shall assume that an order has been received for 500 aeroplanes to be delivered in lots of 50; also that the price is considered satisfactory and that the

FORM 3 JOB No. 10 G.P.

Mr. [illegible]

ORDER DEPT.

Please order and arrange for delivery to stores of material and articles mentioned hereunder:- Complete schedules Waterman Aeroplanes

Required first Schedule 3

Follow with, in order mentioned: Schedules 52, 7.

Sets required: Lots of 50

Total Orders: 500

Notify Planning Dept. of your progress:

Date: 23/11/17 Signed K —

Received by Order Dept.	Date:	Signed:

FORM 4 JOB No. 12 G.P.

Mr. [illegible] —

PLANNING DEPT.

Please note that the following can be met by stock in the stores at this date: Complete schedules 3, 5, 2, for first 50.

Item	No in stock	No per set	No required
3-4	56	50	—
3-12	102	100	—
3-15	47	50	3
3-21/34	24	50	26
5-17/21	121	100	—
2-1/7	300	200	—
2-8	61	50	—
2-9/10	92	100	8

Date: 25/11/17 Signed: Q —

Received by Order Dept.	Date:	Signed:

factory is in a position to execute the order. We will call the aeroplane the "Waterman" type.

Once the order is received—through the post, by telephone, or otherwise—it must at once come to the manager, who should himself sign the order to the planning department for the work to be executed in the factory.

The order signed by the manager should be on a form similar to Form 1 and should be in duplicate—one copy for the planning department and one for the file.

It will be noted that the Government order number is dropped for obvious reasons and a factory number substituted, and, for convenience, each 50 has its proper symbol. W.G.P. in lots of 50 will mean, to the initiated, an order for "W" type machines. G.H.I.J.K.L.M.N.O.P. lots of 50, or a total of 500. The first lot of 50 will be "W.G.," the second "W.H.," and so on.

For convenience in handling and filling, all forms in use should be on the same size card or paper. They may, however, be distinguished by different

FORM 5 HOLD HERE Job N° W.P. 753
N°

DEPT N° 7

M^r _____

THIS SIDE OUT.

Please Press out side plates

Number required 200

Material: M.S. Plate

Note: Flatten after pressing

Deliver to Store N° 3

Date: 26/11/17 Signed X —
PLANNING DEPT

Received:

Team.	Number	Date	Signature

colours. If the factory uses a system of time cards and clocks, with a card measuring 7in. by 3in., this size should be used for the order forms, for reasons which will be apparent hereafter.

The cost section of the planning department should first receive the order, and should at once open an account and make notes of the various particulars of importance to them. Having done so, the clerk responsible for the entry should sign and date the order.

The planning department now proceeds to justify its name, and at once arranges for production to commence in the works. In the first place, arrangements for the drawings should be made—Form 2 is used for this purpose.

The whole machine is sectionalised—wings, fuselage, undercarriage, etc., forming each a section. Preferably, the sections should be limited to nine, to fit in with the numbering scheme hereinafter dealt with. A section of the aeroplane is next selected, preference being given to the section which will take the longest time for its production. It is minutely sectionalised and its parts properly scheduled. A copy of this schedule should be sent to the order office, accompanied by a form similar to Form 3.

The parts which require to be bought outside complete are clearly marked on the schedule. It will be the duty of the order department to see that the rough material is actually in the stores at the earliest possible moment. The order department must clearly recognise that their duty does not terminate with the ordering, but with the actual delivery. They will also keep the planning department advised of their progress, item by item, if necessary. It is quite possible that a lot of material required for the job is already carried in stock, and the order department must advise the planning department of the position in this connection. See Form 4.

Meanwhile the planning department should have mapped out the production and allocated the work to the various departments. Forms for the production of each item, and in a number of cases, the part production of each item, are prepared. In fact, every operation of each part is provided with a written order. This may appear to be a stupendous task, but a moment's consideration will show that it is always done, but that, in a large number of cases, the work of writing these forms is scattered throughout the works, such as at the desks and offices of foremen and charge hands.

These order forms (Form 5) are preferably made out in duplicate, one copy is filled and the carbon copy is conveniently made on the back of the clock job card above referred to. The number or name of the department in which the work is done is filled in, and in fact every other item at the head of the card, except the workman's name—this being, of course, left to the discretion of the foreman. An order for the material required from the stores is also made out and attached to the production order, Forms 6 and 7.

It will be noted that there are two stores mentioned. (1) The rough stores, and (2) the departmental stores; the nature and reason for these stores will appear later.

The foreman in the department concerned will be furnished with these orders —Forms 5, 6, or 7, by the planning department whenever the latter arrange for the work to be done, but never before they know that the requisite material is available in the stores. As the men under the foreman require work, he will fill in their number (or name and number if required) on the forms, and hand same to them. They will "clock on" the back of Form 5 and take Form 6 or 7 to the stores, draw the material and sign the receipt for same. On the completion of the job, the parts completed will be delivered to the proper stores and the receipt for same signed. All forms will be returned to the planning department, so soon as they are completed, and the duplicate on file can then be destroyed. Until destroyed, these duplicates form a record of the work in progress and an automatic check against the loss of any job.

Where the rule exists to check and balance the job and time cards weekly, it will be necessary for the foremen in the different departments to have duplicates made of all job cards carried over to the following week and the card so continued should be suitably marked, preferably they should be of a different colour to the ordinary job card. In this case also, all job cards will pass through the time-

keeper's department for checking with the time cards before they go back to the planning department.

Should any "scrap" be made, extra material would be requisitioned through the planning department, who may issue a further order on the stores. Preferably, such orders should be on a distinctive coloured paper, so that they may be picked out as orders for replacement for "scrap." Too much attention cannot be drawn to this matter if economical production is to be attained.

FORM 6. Job No. WL 753

Mr. G

ROUGH STORES

Please issue:- 16 G. MS. Plate

Quantity:- 36" x 30"

Date 26/11/17. Signed:- X

PLANNING DEPT.

Received From Stores:-

Item.	Quantity	Date	Signature.

FORM 7 Job No. WL 751

Mr. W

STORE No. 3.

Please issue:- parts

Quantity:-

No 752 tubes 85

" 753 plates 170

Date:- 30/11/17 Signed:- X

PLANNING DEPT.

Received from Stores:- 3

Item.	Quantity	Date	Signature.
No 752	85	3/12/17	[signature]

In order to record progress of work, use should be made of some chart. A simple, compact way of doing this is shown in Form 8. A convenient size for the card is 8in. by 5in. Some cards should have extra spaces on the back to accommodate components having an exceptional number of parts, or duplicate cards may be used for the same purpose.

Full information regarding the component and its proper classification is provided on the top of the card. The items are enumerated and, if necessary,

the drawing number of each is given. A number of spaces is provided opposite each item and these are used for the different operations. The first column is headed "Stores," and the other columns are for the various departments in which the operations are to take place. Each department is conveniently indicated by a number permanently assigned to it. The number indicating the department should be written in red ink as large as possible. See Form 8.

Each space is divided by a horizontal line and each space so formed is again sub-divided by a horizontal and four perpendicular lines, thus providing two blocks of ten small sections to each space.

Shading with lead pencil the ten sections at the top of the horizontal line will show at a glance that the total number of the particular items called for have been received by the department indicated; whilst the shading of the sections below the horizontal line will indicate that the work on the items has been completed in the particular department and deposited in the proper stores, and that the job card has duly returned to the planning department. The date on which the particular movement of the item occurred, may be noted in ink over the shading. If, for any reason, the requisite number of any item is not received or produced by any department, the position can be shown by the number of sections shaded or parts of sections. This is shown opposite the fifth item, Form 8.

For instance—Department 1 received material for the production of 200 side plates; owing to "scrap" 180 were produced, consequently only nine of the ten sections are shaded. As the "scrap" is not to be made up, the 180 are passed on to department 9, and this is shown by the shading of nine spaces only. Department 9 also makes "scrap" and thereby loses 10, consequently only 8½ sections are shaded, showing 170 side plates passed on by this department.

Referring again to the first column, *i.e.*, the stores record, the top spaces are shaded when instructions for ordering the material have been sent to the order department. The lower spaces are shaded when the planning department has been notified that the material is in stock. The date in this space should show when the orders for the work to be put in hand were sent to the shop.

If desired, the progress card may be smaller in size and one card assigned to each item. If this is done, a ready means is provided for seeing at a glance the amount of work in progress in each department. This will be described in detail later.

It is now necessary to mention the system employed for numbering the various jobs. This is an adaptation of the decimal system in use in some libraries.

No doubt members have had some experience of the long official numbers used by the Government to designate their contracts. A number like A 463/13/1432 will serve for an example. To saddle a job, and all the parts of it, with a number like this, is asking for trouble. Its use means loss of time, worry through mistakes and consequent loss of output. I believe "every little helps" in the question of output, and that, whether one is to save time in the production of battleships, aeroplanes, or packets of matches, every moment saved is a moment gained. A few moments' thought will convince anyone acquainted with the records necessary in even a small factory, that the aggregate of the time

FORM 9 | Name and Number of Parts. Waterman Aeroplanes | Our Contract No. W.L.

Section No. Military Equipment W.L. 7 | Component No. Gun Bearers W.L. 75

Remarks | Schedule No. 3 | Drawing No. 1908 W

No.	Description	No. Off		Stores	Dept.	Dept.	Dept.	Dept.	Dept.	Dept.	Dept.	Dept.	Dept.	Dept.	Dept.
751	Arch tube bearers	200	In		2										
			Out		2										
752	Stay tubes	100	In		3										
			Out		3										
7511	Arch tubes front	100	In		3	7									
			Out		3	7									
7512	Arch tubes rear	100	In		3	7									
			Out		3	7									
753	Side plates front	200	In		1	9	7								
		170	Out	24/1/18	1	9	7								
754	Side plates rear	100	In		1	9	7								
			Out		1	9	7								
755	Front longeron clip	200	In		1	4	3	7							
			Out		1	4	3	7							
7551	Front clip starboard	100	In		1	9									
			Out		1	9									
7552	Front clip port	100	In		1	9									
			Out		1	9									
75521	C.S. strut socket	100	In												
		100	Out	24/1/18	1	2	To be worked to 7552								
75521	Longeron Plates	200	In												
			Out	24/1/18	1	2	To be worked to 7552								

wasted in writing the long numbers such as that mentioned above, must run into days.

As already stated, my method is to give the contract a certain letter. A contract for a number of "Waterman" aeroplanes is given the letter "W," and if we subdivide the number into lots of, say, 50 each, each lot is given a second letter as "WL." The unit required in the contract—in the example under consideration, the aeroplane—is divided into a number of sections, but not more than nine, and subsequent subdivisions are limited to ten, and are numbered consecutively, as:—Wings 1, centre section 2, fuselage 3, tail 4, undercarriage 5, power plant 6, military equipment 7, struts and bracings 8, controls and instruments 9.

Each section is divided into components limited to ten. For instance, the military equipment section, number WL7, is divided into:—Gun complete 1, magazine case 2, ejector funnel 3, control gear 4, bearers 5, wind screen 6, sight 7.

Each component is subdivided into parts. Take for example the gun bearers. These, numbered WL75, would be divided into:—Arch tube bearers 1, stay tubes 2, side plates front bearer 3, side plates rear bearer 4, front longeron clips 5, rear longeron clips 6, fork piece 7, bolts 8.

Each part is further divided into items, thus the front longeron clips, numbered WL755, may be split into:—Front longeron clips starboard 1, front longeron clips port 2.

If desired, the division may be carried still further. The front longeron clip number WL7552, may be subdivided into units:—Centre section strut socket 1, longeron plates 2. These are single pieces and cannot be further subdivided.

The longeron plate will be numbered WL75522.

This is not a very large number, but in the most complicated pieces no greater number of figures should be required. A moment's thought will make it clear that the long numbers are used less frequently than the others since they only apply to the units. The job card for welding up the front longeron clip would be numbered WL755. But the man who assembles the gun bearers has a card numbered WL75.

Once the main subdivisions are made they should remain as far as possible standard for all types of machines.

The advantages of the system will be apparent. A lot of similar small parts are found in the factory in an unfinished state. The number on the label attached to them, or the job card with them, is WL726. We know from "W" that they belong to the Waterman type of aeroplane. From "L," that they are on a particular order for these machines. The 7 shows that they are part of the military equipment. This information will probably be so near a guide to one who is used to the work, that he will at once recognise the part, but if not, the 2 will show that it is a part of the magazine case.

Of course the same system could be used in connection with traction engines, agricultural implements, or any other machine or article of manufacture.

It is impossible to deal with all problems peculiar to each factory, which may occur in the working of this scheme and for which special arrangements must be made. However, there is one point requiring a little explanation. A foreman very often will desire to put more than one man on a job. To meet this emergency, each foreman should be provided with a number of blank forms similar to Form 5, but clearly marked, preferably by the use of a differently coloured card to that used for the original order. The foreman will be responsible for the form being properly filled up. These extra cards will travel through the works and eventually back to the planning department in exactly the same way as do the original forms which they supplement.

In some concerns it may be desirable to keep track of the work almost hourly, for example, when the work is carried on by more than one shift. To meet this requirement, the progress cards, Form 8, should, as above mentioned, be substituted by the small size cards recording single units.

Such card, say, 3in. by 2in. in size, is provided with at least two pilot or index clips or flags. The preferred form, made of enamelled steel and obtainable through any good card index makers, is shown in Fig. 9. They should bear numbers to indicate the department to which they refer. At one side of the top edges of the cards is placed the proper flag indicating the department in which the work is in progress. The other flag on the opposite end of the top edge should bear the number of the department to which it next has to go. Further flags, coloured red, may be used to mark jobs which have to be "rushed." Flags coloured black may be used to show jobs temporarily held up for some reason or other. These special flags may be placed towards the centre of the top edges of the cards.

A box of cards indicating all the jobs at the moment in the factory will contain perhaps as many as 1,000, 10,000, or 100,000 cards, but will show at once the position of each department so far as work in hand is concerned.

This system, in a large shop, having a central store, view-room or inspection department, acting as a pool between each operation, may easily be worked by the clerk checking jobs in and out of said pool.

Of course the cards should be kept in proper order so that the position of any job may be ascertained at any moment.

A final advantage in this system will be found if two files or boxes for the cards are used. At the beginning of a week, or month, or any other period, an empty file is used. The first card to be moved, say on Monday morning on a weekly system, is taken from the old file and placed in the new one. Any new cards coming in are, of course, placed and filed in proper order and with the proper flags in the new file. At the end of the week the old file should be very thin, whilst the new file should be correspondingly full. Before starting the new period, the next week, the cards which have remained stationary in the old file should be removed and handed to the superintendent or manager, who would thereby have a positive and automatic means of seeing what jobs have remained stationary for the week. He can order any card to be replaced in the current file or otherwise dispose of same, as he thinks fit.

As a final warning, no system will be good unless the head man backs it and obeys its laws; every man, boy, woman and girl in the factory and offices should have their duties defined; each should understand as far as may be necessary the system of organisation so that each one may assist to make the system so simple and complete that it automatically "runs itself."

SEVENTH MEETING, 53rd SESSION.

An Ordinary Meeting of the Aëronautical Society of Great Britain was held in the Hall of the Royal Society of Arts, London, on Thursday, March 14th, 1918, at 8.0 p.m., Mr. G. Holt Thomas presiding.

The CHAIRMAN said the lecture that evening by Mr. W. E. John, on "Shop Organisation," was a little departure from the usual practice of the Society, but a very necessary one at the present time. We had good designs in England, but it was no use having good designs without good production, or vice versa. The lecture was particularly opportune at present, as he (Mr. Thomas) thought it would be impossible to organise any aircraft factory in England under the conditions which existed before the advent of the Air Board and the Air Ministry. It was impossible to organise without material, or if sufficient orders were not received, or if the authorities did not know what they wanted. But under the Air Ministry we had now departments for material inspection, and things had much improved. Another thing that stopped work was that the output of aeroplanes was formerly largely controlled by the number of times the Germans bombed London, the result being that works had to be doubled just when organisation was contemplated. He thought that had now probably come to a standstill and that the present was a most opportune time for the discussion. He was always striving at organisation, which, as Sir Henry Fowler would tell them, they had never got. The paper by Mr. John, he thought, would help them to obtain it.

Mr. E. W. JOHN then read his paper on "Shop Organisation."

Sir HENRY FOWLER said he was compelled to take part in the discussion by the remarks the Chairman had made. They must all appreciate that there had been no more difficult matter placed before the engineering world than the construction of a machine like the aeroplane, which was developing almost from hour to hour, and in time of war. It was absolutely necessary to give the fellows who were fighting and risking their lives for us the very best, but something happened from time to time which pointed out that some slight alteration would give advantages, and that was one of the most damning things that could happen from a construction standpoint. Almost hour by hour they had to decide what was to be done. No matter ever had the complexity of this manufacturing of a new type of mechanism in the course of development that aeroplane manufacture now had, but the country and the engineers were to be congratulated that we had done so well. Organisation to deal with shell, with fuse, with cartridge cases, or with propellers, was comparatively simple, and, though an alteration practically affected the whole of the machines in the shop, one could carry on, and it was not the trouble which one got in the alteration of small aeroplane parts. The very large number of these different parts was exemplified in a wonderful manner by the figures given by the author. Mr. John had not put down for absolute comparison what would happen to his second set of figures if there were more than nine parts in any of these sections into which he had split it up. He would have found himself running in competition with the long figure he had given as an example of a shop number used in another system. Mr. John had shown them an excellent example of the kind of man it was necessary to put into the shop with his proposed organisation. The manager must be wholeheartedly on the job. A fellow who had had to deal with a more simple proposition said this organisation was needless, and he got through his work, but not at the time he ought to do. There was not only the difficulty with the managers and the foremen, but also with the men themselves, who thought if they left out a number or put in an extra number or a wrong number they would be paid just the same, and it was a matter of difficulty and patience to teach them to use the system. Anyone who had had to

deal with aeronautical work had realised the importance of such a system, and the Society was to be congratulated upon having Mr. John's paper.

Major HECKSTALL SMITH said the paper was valuable, and the system proposed departed from the majority of the existing organisations, but the departure was a good one. It established the great importance of a planning department and of dividing the work up into small sections. It was a great thing to divide aeroplane works up in that way, and it was not a thing that was done universally. The author put the costing department under the planning department. Would he say why he had done that? He (the speaker) had hoped that he would have gone further into the real valuable functions of that department, as it was the brains of the works. Highly skilled people must be employed in that department, otherwise they would do more harm than good, and its personnel was the most important of the whole works. He took it the author meant the planning department would not act in the old fashion that used to exist when the foreman gave instructions to the workman as to how work was to be done—it still held in many works in England—but that the planning department took away from the foreman the clerical and instructional work he used to do and only left to him the selection of the men and the watching of the work of the men. Would the lecturer give a few words on the primary functions of the planning department and the class of men he would employ? With regard to checking the work in progress and the material, he did not agree with using quite such small cards for watching material which came in in driblets, or for the progress of the work. They wanted something large to hang on the wall and which would hit you in the eye, and a colour scheme might show whether you were up-to-date or not, the work behind being indicated by red and the up-to-date work by black. Supposing the planning department had put the work through and the progress department was told to watch for a certain number of items every day or week. The foreman would be instructed to do ten articles every day or week, and when the progress sheet was passed one would see whether the articles were or were not coming in and would indicate by red or black whether the foremen were up-to-date with their promises or not. Otherwise, he approved of the scheme, which was an excellent one.

Captain HISCOCKS said he thought the paper should show the conditions applying to the works into which the author was putting this organisation; also the size of the works—500, 5,000, 50,000 hands—was a consideration. Did the author make the whole of the aeroplane in his own works, or how much did he buy outside? For a works of 500 men the system was a suitable one, but with 5,000 men the paper record would be so large that the whole thing might fall to pieces, and he would have to change over from a paper progress system to a minimum and maximum stock system, which would be more accurate. The dividing up of aeroplanes into main parts and groups seemed to him to fail to pieces in some respects. There might be half a dozen orders in the shop for manufacturing the same parts, and probably the foreman would overlook them and put them through in half a dozen batches instead of one batch. There were many parts which it did not pay to put through in batches of 50; they would have to be put through in batches of 500 for economical production. The progress charts did not take into account that a large number of parts might have been withdrawn for spares, emergency orders, etc., and that threw out of balance the progress sheets, and the progress sheets could not show exactly where all the different parts were going. They might show what was coming in, but they might be withdrawn from the stores and certain parts might be found short when one came to the finished aeroplane.

Mr. GORDON ENGLAND said there was a great tendency to view organisation from the point of view of the organisation, and not from the point of view of the work about to be tackled. A system could apply to a small or a large works

equally, provided the main thing was kept in mind, viz., the job which was to be produced. The organisation should centre round that, and not round the works or the men employed. Every branch of engineering required a special organisation, a different one being required for aeroplanes and ships, for instance. A point which upset him was the question how one dealt in Mr. John's system with any one part, as it appeared in these days of standardisation that that part would have several different numbers in the one machine. One of the main things to do was to cut down the different references to one item to an irreducible minimum, otherwise a field was opened up for enormous error, because the foreman would be upset greatly by the fact that one part was known in the works by three or four different numbers. If it were reduced to one everybody would always recognise it. There would be less errors on the clerical side, and less mental effort would be applied to remembering and identifying that part. There were great risks if a part had several different numbers or references of putting those parts through separately instead of in one bunch. He suggested that the best method of dealing with those parts was to let the planning department put them through as parts of a whole order, and not with reference to any one section. That would obviate setting up a machine to produce a few of them and then breaking down the machine and setting it up for some totally different article. The first duty of the planning department was to see how much labour they had under any one head in the works. For example, how many skilled men or unskilled women they had on any one operation. They could then state definitely what their output of any one article could be, and it enabled them to balance the whole works in such a way that no one section would be producing more of one article than was required to balance the production of the various other items in an aeroplane. He found that practice was possible and that it paid. He would like to have Mr. John's criticism on those points.

Mr. R. Borlase Matthews said the paper covered a somewhat new field and made one wish for further information. He would like a little more information as to how the lecturer used and applied his costing. In many works the costing figures were not available as quickly as they might be to serve their term in reducing the cost of production of further batches. He had been interested in mechanical methods of calculation, and one of the best examples he had seen was at the R.A.F. works, which Sir Henry Fowler lately controlled. They had a system of machines whereby detailed costs could be analysed rapidly. One such machine was known as the Burroughes machine, which was used for the wages portion, but for the works analysis and costs of operation the Powers counting machine carried the thing out in careful detail. He would have liked greater detail as regarded the planning of the work along the line of putting what might be called more of the brain work into the arrangements for facilitating the work of the foreman and the men. That was an application of what was known as Taylorism in workshop management. As regarded the wood working portion of aeroplanes, there was great scope for the use of jigs in the manufacture, rather from the view of the management—that is pre-planning, rather than letting the planning slide to a later time when the work actually got into the shops. The lecturer had remarked that he went ahead with the work if the order received was satisfactory. That reminded him that some American firms if they found the price was not satisfactory re-designed the job, but possibly the Air Board would stop that sort of thing here. He had used the decimal system of classification in engineering for 15 years, and found it very useful. He had even introduced it into the Air Board, which was rather apt to act on conservative, War Office lines. He divided the aeroplanes into nine parts and one general miscellaneous part, and took them alphabetically. The parts were armament, ballast, engineering fittings, the fuselage, instruments and fittings, landing gear and anchorage, the main planes, the tail, and the tanks and pipes. This system of numbers was not appreciated quite as it might be in this country, and it was most useful that a

number instead of being a mere number should tell something definite about the thing which was being dealt with. In America and on the Continent they had this system in use more generally than we had in England. A bedroom numbered 210 meant the tenth room on the second floor. On the underground railways here a controller car bore the number of 300 upwards. A middle car with motor control both ends bore a number of 200 upwards, and an end car a number starting with 100, so that the manager knew by the number what kind of car was referred to. The question had been asked how one managed if the article were only divided into nine parts. But when one knew the system it was not difficult. There was a standard size bolt used on the main planes, fuselage, or anywhere else. It went on a quantity basis, and it was a thing with regard to which the planning department would have started out on that basis. Works that produced bolts of a certain size on a batch basis would not show evidence of much brains in the planning department.

Mr. W. E. JOHN said, in reply to the discussion, with regard to the remark about dividing into nine sections, anything could be divided into less or up to nine different sections. He did not use 10 because the "0" was a figure the workman did not like. The workman, if he had no experience of decimals, dropped the "0" if it began a number. With care, anything could be divided into nine. He was asked by a lady in one of the factories, who had charge of the filing of the correspondence, to adopt this for her filing, and he found one could divide her filing into nine main sections, and from that it was again divided into ten, and the sub-division increased as far as necessary. Sir Henry Fowler referred to the fact that the above system would be up against having the wrong numbers put on the job by the men. In the system he had sketched every order was written, in the first place anyway, by the planning department, and if there was any copy required it was due to two men being put on one man's job, to meet an emergency. It was a plain copy made by the foreman, and if the number was dropped or there was anything wrong with the copy it was not hard to trace it when it came through the shops, because they had the original, made out by the planning department. Another speaker asked why the costing section was put under the planning department—why the planning department was divided into cost and progress. It was really the obvious thing to do. "The coat had to be cut to fit the cloth," and the cost department should have some say in the way the progress of the job through the shops was planned. The type of man he would put in charge of the department would be a man who had served an apprenticeship in, and had very wide experience of the actual production of the workshop. It was very difficult to get the right man, as apprentices were not often good office men. The man must have passed through the real details of a factory, and know something of accountancy or costing. Major Heckstall Smith said he wanted his records posted large, but this meant papering the walls of a very large room. The number of jobs in an ordinary factory would want a lot of room to be all readily visible at the same moment. A scheme of this kind used to be in operation at a place where he worked at the time in the West of England. They had a system of flaps, such as were used for advertising postcards, and these were used to show the different positions of jobs. With regard to small parts of aeroplanes being numbered twice over, wood screws, for instance, were used in all parts. Few aeroplane factories would produce these screws. That would be a stock job. If the numbering scheme were to be applied to small parts bought outside, or small clips, or anything used in quantities, they would give it "Sk," which meant "stock," and number it accordingly. It was true that spares came in and that there were emergency orders, but if an emergency order came in for 50 sets of wings it should not interfere with the original contract, which went on just the same. The emergency order was put through separately, and the right clip put on it, and it was sent as a separate order through the whole organisation. Coming back to the stock, the screws might be different sorts, and after "Sk"

one could add the figures 1 for round head, 2 for countersunk, 3 for metal thread, or anything else. If it were a wood screw it might be No. 8, or start in any size which was suitable to the factory, so that the " 1 " might be divided into 1, 2, 3, 4, 5, and so on, for different varieties. Or one might use 1 for iron and 2 for brass, and then divide those numbers into 1, 2, 3, and so on. They knew No. 1 was a round head, and if it was 11 it was iron right through the series. This could also be done with turnbuckles, or anything else used in quantity. It would take too long to give an example of the costing system at that meeting. The system had been built up with the idea of arranging works something on the Ford principle, where units could be made as far as possible complete in one department, without handling them all over the place. He believed the decimal system of numbering was first introduced at a library in America. There was a catalogue, he believed, that was standardised, and could be bought from American agents.

The CHAIRMAN said he was somewhat overcome because the lecturer told them they must be satisfied with the price. He turned his head and saw £740. He hoped it was not a Gotha or a Handley Page. The lecturer also said the system could be carried further. He thought it was a question of where to stop. The author's system seemed a simple one, and the decimal system was also interesting. Sir Henry Fowler mentioned the enormous number of aeroplane parts, and there were also many kinds of materials. The difficulty was how to stop the extension of the system before one was overwhelmed. The paper was very interesting and had elicited a very interesting discussion.

He moved a hearty vote of thanks to Mr. John, which was carried unanimously.

Major-General RUCK (President of the Society) moved a vote of thanks to Mr. Holt Thomas for presiding, which was also carried.

THE NOMENCLATURE COMMITTEE.

The appended letter has been addressed to the Chairman of the Society from the Chairman of the Nomenclature and Technical Terms Sub-Committee of this Society and the Engineering Standards Committee:—

27, Buckingham Gate,
London, S.W.1,
March 22nd, 1918.

The Chairman,
The Aëronautical Society.

SIR,—Your Nomenclature Committee has in the course of preparing lists of terms for common adoption in the scientific work dealing with the general dynamical theory of the aeroplane, come to the view that the value of this work would be very greatly extended by the inclusion in the list, which will eventually become officially recognised, of a system of symbols to represent the mathematical conceptions involved. This matter was mentioned to the American delegation, which deputed three members to attend at one of our committee meetings, and it also met the approval in principle of the Joint Conference of Allied Delegates, summoned by the Engineering Standards Committee.

The system of symbols and notation recommended by your Nomenclature Committee for adoption is the one which is unquestionably most widely used both in this country and in the United States, and it is that one which was first employed in the publications of the Advisory Committee and is employed by the National Physical Laboratory and the Royal Aircraft Factory.

The Committee desire that I should, however, draw your attention and that of the Council of the Society to the work of a distinguished member of the Society, Professor Bryan, who in the course of what we believe to be the earliest application of standard mathematical methods to the consideration of the stability of the aeroplane, used a different system of symbols, which has not been so widely adopted. Your Committee is of opinion that the mathematical method underlying both systems of notation is definitely due to Professor Bryan, and although it is no function of the Nomenclature Committee to concern itself directly with matters of priority, it expressed the desire that the attention of the Council should be drawn to this matter in the hope that the Council would see fit to recognise Professor Bryan's priority.

The Committee considers that the cause of standardisation and the attendant advancement of the scientific study of the dynamical problems of the aeroplane is of such great importance that the course which it has adopted in selecting that system of symbols which is much the most widely used, is fully warranted, and they feel this, notwithstanding that they have paid serious attention to the valuable contribution made by Professor Bryan to the AËRONAUTICAL JOURNAL on this subject.

Faithfully yours,
(Signed) MERVYN O'GORMAN,
Chairman of the Nomenclature Committee,
Lieut.-Col.

This letter was considered at a meeting of the Council of the Society on March 26th. In the opinion of the Council the action taken by the Sub-Committee was to be approved, and the Council now desire to place on record their full recognition of Prof. Bryan's priority in the investigation involved.

W. BARNARD FARADAY,
Secretary.

CORRESPONDENCE.

To the Editor of the AËRONAUTICAL JOURNAL.

H.M.S. "Ark Royal," c/o G.P.O., London,

February 24th, 1918.

DEAR SIR,—In the October-December, 1917, number of the AËRONAUTICAL JOURNAL, in the obituary to the late Mr. Horace Short, on page 457, it is made to appear that a flight from Isle of Grain to Plymouth was made in a Short seaplane. This flight was made in a 70 h.p. Maurice Farman.—Yours faithfully,

J. W. SEDDON.

To the Editor of the AËRONAUTICAL JOURNAL.

Chandos House, Cricklewood, N.W.2,

March 12th, 1918.

DEAR SIR,—In various articles on flying I have noticed considerable confusion over the quotation of distances. I should be glad if you would kindly inform me whether there is, so to say, a "standard" mile for the computation of aerial distances.

The geographical mile and the mean nautical mile (or knot as usually adopted for use) approximate at about 6,080 feet. The English land or statute mile is 5,280 feet. In navigation distance is invariably measured in nautical miles. The English statute mile is the mile generally associated in the United Kingdom with the internationally used "natural scale" (*e.g.*, 1 : 125,000), and is the "mile" as understood by the "man in the street."

As a difference of about fifteen per cent. may be involved the "layman" would naturally like to be enlightened regarding the unit in use.—Yours faithfully,

E. B. BURLEY.

[Aerial distances are usually given in the statute mile.—ED.]

REVIEWS.

Glossary of Aeronautical Words and Phrases. London: Aircraft, Ltd. 2nd Edition. 48 pp. Diagrams and illustrations. 1918. 1s.

This is a revised version of the Glossary published by the same firm last year. The usual bone of contention appears in this, as in most other aeronautical glossaries, as will be seen from the following definitions:—

Airscrew.—Used as a generic term to include both a propeller and a tractor screw.

Screw.—Airscrew; rotary bladed propeller for aircraft.

Pusher.—Aeroplane with propeller behind.

Propeller.—An airscrew behind the main supporting surfaces.

Tractor.—An airscrew mounted in front of the main supporting surfaces.

Thus a pusher is an aeroplane, while a tractor is an airscrew. An "airscrew" is a screw, which is both propeller and tractor, but a "screw" is merely a propeller. A pusher has its propeller behind it. This, it may be observed, is where one would expect to find it. For an aeronautical glossary, the one before us is perhaps overburdened with unnecessary inclusions. It was surely not essential to define such terms as oxygen, aluminium, angle, axis, eccentric, draughtsman, and diameter. The booklet is well illustrated.

W. B. F.

The Resistance of Air. By Lieut.-Col. R. de Villamil, R.E. London: E. and F. N. Spon. 1917. 192 pp. oct. 7s. 6d. Illustrated.

It is not often that text books on aeronautical science are so admittedly controversial as Colonel De Villamil's latest work, "Resistance of Air." This volume may be said to form a sequel to the author's previously published works on fluid motion, but in this case the subject is treated with special reference to a particular fluid, namely, air. The author in a characteristically vigorous introduction defines the aim and scope of the book as an attempt to enunciate the law of the resistance of air and the value of the coefficient for the flat plates of about one foot square.

Much of the main argument is based on the experimental work of Dubnot and Duchemin, as well as that of De Borda, Hutton, and Newton; and whilst one may be prepared to accept such as good evidence in support of the author's point of view in regard to "relative motion," yet it would appear that such fundamental questions as he raises should be finally settled rather by modern hydrodynamical theory than by any set of experimental results, however complete. As Mr. Lanchester once remarked, "You can prove anything right or wrong by experiment."

Apart, however, from the more contentious portion of the book, there is much experimental data on the resistance of air that is very interesting and will repay careful study, among which may be mentioned Bashforth's experiments on the resistance of shot at high velocities, together with the work of Zahm, Piobert, Didion, Mallock, and others. The whirling machine experiments of Langley, Dines, Renard, Beaufoy, etc., are also enumerated.

The two concluding chapters are devoted to modern wind channel research, both in this country and in France, whilst the so-called "dimensional effect" and the "virtual mass" of bodies having an accelerated motion in a fluid are vigorously discussed in the light of experiment.

The book has the defects of its qualities, but it should provide much food for thought for anyone who is not prepared to accept statements with regard to the truth of laws without a first hand investigation.

M. A. S. RIACH.

RECENT ADDITIONS TO THE LIBRARY.

"Aviation Engines, the Design, Construction, Operation and Repair." By Lieut. Victor W. Page, Aviation Section, S.C.V S.R. New York: The Norman W. Henley Publishing Company. 1918. London: Crosby, Lockwood and Son. Illustrated. 8vo. 576 pp. 15s.

"Airplane Building." Special Catalogue of the Brooklyn Public Library. 1918. New York. 16 pp. oct.

"Mathematics for Engineers." By W. N. Rose. London: Chapman and Hall. Oct. 510 pp. London. 1918. 8s. 6d.

"Aircraft in War and Commerce." Introduction by Lord Montague of Beaulieu. By W. H. Berry. London. 1918. E. J. Burrow and Co. 158 pp. Illus. 1s. 6d.